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MINISTRY OF FINANCE, EGYPT.

**NOTE ON THE
PROGRAMME AND POLICY OF THE GOVERNMENT
WITH REGARD TO THE
INVESTIGATION AND DEVELOPMENT OF
THE PETROLEUM RESOURCES OF EGYPT,**

BY

E. M. DOWSON, C.B.E.,

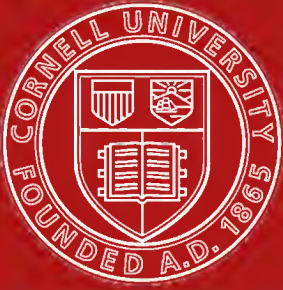
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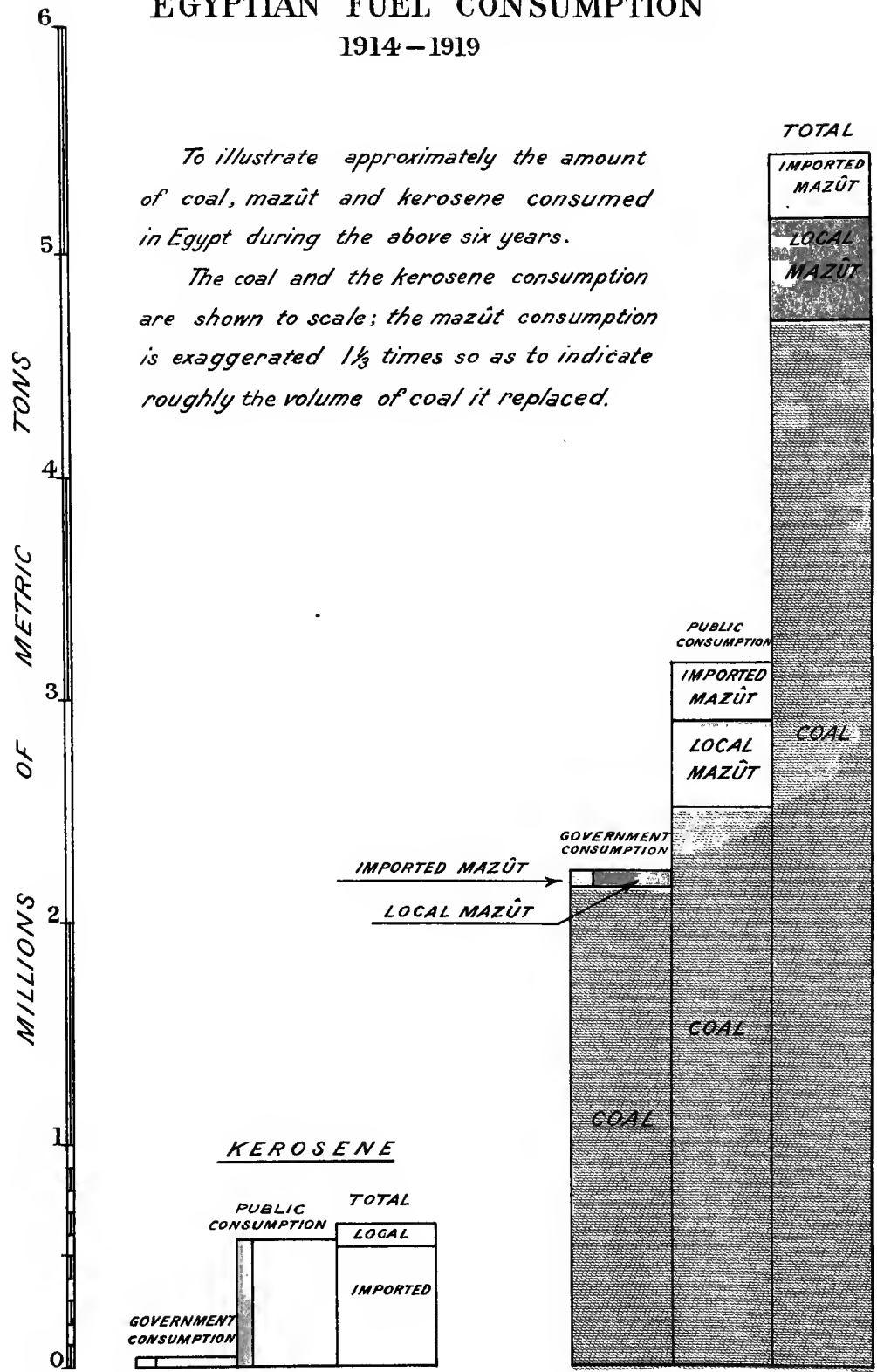
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EGYPTIAN FUEL CONSUMPTION

1914-1919



MINISTRY OF FINANCE, EGYPT.

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INTRODUCTION.

The accompanying note on the programme and policy of the Government with regard to the investigation and development of the petroleum resources of Egypt has been drawn up with the assistance of various members of the Petroleum Development Committee, more especially Messrs. Greaves, Lucas, and Hume. It was originally prepared for publication last summer, and references to next season's work, etc., must be read accordingly. This delay in publication, due to preparation of the maps and appendices and to pressure of other duties, is much regretted. Hassan Effendi Sadik, who has annually been a member of the geological research parties, has undertaken the difficult task of translating the note into Arabic and endeavouring to make its meaning clear to the general mass of non-technical readers in the country. It is proposed also, in due course, to publish the note in French.

E. M. DOWSON,

Under-Secretary of State for Finance.

Cairo, December 1920.

NOTE ON THE PROGRAMME AND POLICY OF THE GOVERNMENT

WITH REGARD TO THE

INVESTIGATION AND DEVELOPMENT OF THE PETROLEUM RESOURCES OF EGYPT.

1.—Preliminary Note on Petroleum.

As the accompanying Note is intended more for the public than the specialist, a few introductory words may assist a general comprehension of the subjects dealt with.

Petroleum, like coal, is a comprehensive term for a substance which although possessing certain common features yet varies in composition and character within wide limits. Although the origin of petroleum is still uncertain and may, indeed, be far from uniform, petroleum may yet be conveniently regarded as the liquid counterpart of coal, provided that its geological association with or its occurrence under the same conditions as coal, is never presumed.

The enormous preponderance of the world-known deposits of coal over the known deposits of liquid petroleum, and the extreme improbability that the latter can ever entirely or even largely replace the former, should also be firmly grasped. The total annual output of the coal mines of the world before the war, and when again in proper working order, may be assessed at 1,500 million tons, while the world's total output of petroleum is only in the neighbourhood of 72 million tons even to-day.

This discrepancy should, of course, act as a spur rather than a deterrent to countries like Egypt, whose territory holds little promise of containing coal deposits,* but whose potentialities, as regards petroleum, are definite though still largely untested.

The location of coal is, however, a far surer process than the location of petroleum, for several reasons. The origin of coal and the conditions under which it is formed are well understood and have been tested by actual extraction of the coal by hand for hundreds of years; the origin of petroleum is still debated, and, though the nature of its occurrence is better known, the manner of mining it (by bore-holes) neither requires nor permits a similar laying bare of its natural birth-

* See Appendix III.

places. Coal, being a solid deposit, is always found in the actual surroundings in which it was originally laid down, and these surroundings are characteristic and recognizable; petroleum, being a liquid heavily charged with gas, tends, under the joint impulse of its own volatile nature and of subterranean water, to escape upwards into or through the pores of any pervious rock, so that it may ultimately be entirely dissociated from its natal environment.

Such natural movement of petroleum is generally termed migration, and this power of migration is the determining factor in its occurrence in quantities sufficient to repay the costly outlay of location. Under this ever-present tendency to migrate upwards, many great petroleum deposits must have gradually escaped to the surface and been lost through the ages, and in the practical search for workable petroleum deposits to-day attention has to be concentrated upon geological formations in which these volatile deposits may have been trapped and accumulated. Such traps may take the form of over-reaching underground arches or domes of pervious rocks alternating with those of an impervious character, or may be constituted by a sharp, closely sealed faulting or rupture line, or take other imaginable forms; but the part eventually played in the storage of petroleum is similar in kind throughout, though necessarily differing widely in application according to circumstances.

Owing to this migratory characteristic, the most abundant sources of petroleum are deep-seated, since only with depth is adequate protection from leakage to the surface likely to be attained. The difficult problem thus presented to the petroleum geologist and miner may be appreciated when it is realized that to achieve success they must drive their long bore-holes downward to tap these subterranean oil-traps accurately, while conserving the imprisoned gas pressure which then constitutes the most powerful and most economical mining agency for raising the liquid deposits to the surface.*

The crude or natural petroleum as it gushes from the earth is a thick brownish-black liquid, which has to be subjected to a series of distilling and refining processes before it is split up into the well-known commercial petroleum products, *e.g.* benzine, kerosene, solar oil, *mazût* (liquid fuel), etc., and for this purpose the crude oil must be transported by pipe line or tank ship to the petroleum refinery, from which the resulting commercial products emerge in turn to be distributed to consumers.

It will thus be seen that before petroleum lying in natural deposits can be systematically rendered available for consumption it is necessary

* Useful reference books for non-technical readers are "Practical Oil Geology," by Doreey Hager, Macgraw-Hill Book Co. Inc., 6, Bouverie Street, London, E.C., and "Oil Fuel," by Vivian B. Lewes (The Nations Library, Messrs. Collins, London and Glasgow).

to proceed through five definite groups of operations, all of which are closely interrelated and interdependent:—

- (a) *Geological investigation.* Location of potentially petroliferous areas.
- (b) *Mining operations.* Establishment of existence of workable deposits; and the extraction and collection of crude petroleum on the fields.
- (c) *Bulk transport.* Transport of the crude petroleum in bulk to the refinery by tank-ship or pipe line.
- (d) *Chemical treatment.* Determination of the most economical methods of refining the crude petroleum and carrying out the necessary processes on a large scale.
- (e) *Distribution.*—Distributing the resulting commercial petroleum products to consumers.

It must not be forgotten that petroleum is a general name for a substance which, while preserving certain common characteristics, varies within wide limits. Thus in Egypt the crude petroleum derived from the Hurghada field is a relatively heavy oil deficient in the more valuable products (benzine and kerosene) and yielding a heavy percentage of *mazût* (liquid fuel). The Gemsa petroleum is a much lighter and therefore commercially more valuable oil.

To obtain economic results, the products which each type of crude petroleum is required to yield, and the refining processes to which it must consequently be subjected, should be governed by the characteristic of the particular type of crude petroleum under treatment in each case. When the resulting products have to be marketed, the interplay of demand for each possible product must also be followed.

2.—Past Policy of Government.

The policy of the Government with regard to petroleum mining in Egypt, from the initiation of the Department of Mines until recent years, was confined to authorizing applicants to prospect for petroleum in specified areas licensed to them for the purpose, which licences carried the right to proceed subsequently to the actual getting of petroleum products in a specified proportion of such areas to be leased to them under petroleum mining leases. These licences and leases are drawn in the form of agreements between the Egyptian Government and the particular companies or other applicants. They were approved in their present form by the Council of Ministers in 1910 after a careful consideration of the policy involved.

The principle guiding the policy of the Government, to which the terms of these agreements gave effect, was that generally adopted elsewhere, and was based upon the consideration that petroleum mining is an extremely speculative venture, except in well-proved fields. It is generally recognized that such a speculative venture is not one upon which it is proper for any Government itself to embark under normal circumstances, nor had the previous efforts of the Egyptian Government in this direction been encouraging. Consequently, it was considered essential to attract private enterprise to undertake the mining operations required. To achieve this end the conditions offered to private enterprise had to be made attractive, as the risks of total loss of the capital involved were great and the prize had therefore to be in proportion to those risks. It was recognized that the share falling to the Government in the event of success would, as a consequence, be comparatively slight, but, on the other hand, the Government would incur no part of the heavy financial risks entailed upon those undertaking the search for petroleum in Egypt.

At that time, it must be remembered, coal was cheap and plentiful, while the probability of finding petroleum in Egypt in quantities likely to be an appreciable economic asset appeared far remoter than it does now.

The outstanding fact that kerosene and *mazût* (liquid fuel) were available in Egypt throughout the war in adequate quantities, and at prices considerably below those generally ruling elsewhere, was due to the policy that the Government had thus inaugurated. The company operating at Hurghada unquestionably secured a prolific field and has made great profits, but it had previously risked the entire loss of large sums in searching for petroleum when the prospects of success appeared small, while the benefits of considerable local supplies of relatively cheap fuel were obtained by Egypt with no risk at all, and at a time when their value to the country was most timely.

Under the general policy of mining permits adopted by the Government, over 150 petroleum prospecting licences have been taken out by various bodies during the last fourteen years, and it is significant of the prevailing ignorance with regard to the conditions under which petroleum was most likely to be found, and demonstrative of the small prospects of success, that out of all the areas held under these prospecting licences only in two places (Gemsa and Hurghada) have leases for the actual mining of petroleum products followed.

In many cases the areas licensed for prospecting have been abandoned after surface examination ; but in quite a number of places deep boring followed and a considerable amount of money was spent without result. It is estimated that the capital sterilely expended by mining companies in the search for petroleum prior to the war

amounted to three-quarters of a million, which was equivalent to three or four times that sum to-day.

Ever since the inauguration of the Department of Mines the Ministry of Finance has unobtrusively pursued a steadily increasing programme of inquiry and research with regard to petroleum. The rich fields of Galicia and Rumania were several times visited before the war by mining, legal, financial and geological representatives of the Government; while in 1913 Professor Mrazec, the well-known Rumanian expert, paid a return visit to Egypt at the invitation of the Government, and accompanied Dr. Hume, the Director of the Geological Survey, to the Red Sea on a very valuable visit of investigation.

It has also been the policy of the Egyptian Government in modern times to publish for general information geological reports bearing upon the possibilities of natural deposits of economic importance. In pursuance of this policy the Geological Survey, in conjunction with the Department of Mines and the Government Analytical Laboratory, from the first studied the many-sided problems presented by the occurrence of petroleum deposits in Egypt. The inquiry was throughout directed with a view to obtaining and publishing data which would enable petroleum mining corporations to draw their own deductions regarding the potentialities of petroleum mining in Egypt. The aid of a certain number of first class mining companies is, for reasons that will be explained in a subsequent portion of this note, essential to the proper development of the petroleum resources of the country, and, in pursuance of this end, it was the desire of the Government in the past, as it is in the present, to render the results of its research work available to such companies. The problems presented by the occurrence of petroleum deposits in Egypt are baffling, and it was some time before it was thought that the work done was sufficiently valuable to be published, although the public services mentioned were throughout being constantly consulted by those interested in mining. In 1916 the first technical memoir on the subject ("Oilfields Region of Egypt," by Dr. W. F. Hume) was published.

The work of investigation was interrupted by the outbreak of war, but, as the war progressed, the importance of the fuel problem to Egypt became accentuated, and consequently it was decided that the Government ought to press its investigations more vigorously, and over a wider field, as soon as staff and opportunity allowed. In accordance with this decision, a special credit for "Petroleum Research" was provided in 1917, and measures were taken to proceed energetically with the geological survey of certain areas. As it became possible to increase the staff, a wider sweep of investigation was initiated, and during the last year work has been carried out over a

large proportion of Northern Sinai. The preliminary results of these investigations in various directions have been recorded in a series of Petroleum Bulletins, which have been published or are now in the Press.*

At the Government Analytical Laboratory the chemical study of the subject began in 1900, and in this and the following years careful examinations were made of impregnated sandstones, oil shales, and small specimens of crude petroleum collected by the Geological Survey and the Department of Mines in various parts of the country.

During the war the increasing importance of petroleum supplies in Egypt led to a corresponding development of the chemical work on the subject. In 1918 investigations were begun on a much larger scale and a Petroleum Research Section, with a specially equipped building, was organized by the Director of the Government Analytical Laboratory and placed in the charge of a chemist with many years of practical experience in this special branch of technology.

3.—Petroleum Development Committee.

It has for some time past been apparent that research into the character, origin, and occurrence of petroleum deposits in Egypt must be conducted by a team of specialists co-operating unselfishly to a common end. The day of the all-round expert has definitely passed in this, as in all other branches of modern scientifically directed human endeavour. The Government has gradually collected such a team, who work together as a general co-ordinating and consultative committee, under the chairmanship of the Under-Secretary of State for Finance. The executive direction of the various scientific and technical branches of the work is advisedly left to the competent services concerned.

As indicated above, the research work itself falls broadly into three categories whose interrelation is necessarily close and constant:—

- (i) Geology.
- (ii) Investigatory boring.
- (iii) Chemical study.

The Director of the Geological Survey undertakes the first, the Director of Petroleum Mining Research Operations the second, and the Director of the Chemical Laboratory the third.

* See Appendix IV.

The Petroleum Development Committee as at present constituted consists, in addition to the chairman, of the following members :—

Controller, Department of Mines	... Mr. R. H. Greaves.
Director, Petroleum Mining Research Operations...	... Mr. W. A. E. Coxon.
Director of the Geological Survey	... Dr. W. F. Hume.
Director of the Government Analytical Laboratory	... Mr. A. Lucas.
Petroleum Research Chemist	... Mr. W. A. Guthrie.
Legal Adviser	... Mr. C. J. Campbell.
Assistant Financial Secretary	... Mr J. Baxter.
Sub-Director-General, Mechanical Department	... Mr. G. L. Wingfield.

Mr. A. A. Beeby Thompson, of Messrs. Beeby Thompson and Partners, who has acted during the last eight years as General Consultant to the Department of Mines on petroleum mining questions, joins the meetings of the Committee on his periodic visits to Egypt. In addition to the above, a Secretary technically qualified to deal with Petroleum questions (Mr. Bowman) and a Geological Secretary (Hassan Effendi Sadek) have been nominated.

The Committee also acts in an advisory capacity to the Minister of Finance with regard to the many-sided and complicated questions that arise for decision out of the relations between the Government and the petroleum mining companies, when these questions require similarly co-ordinated consideration. Now that a permanent nucleus has been provided in the shape of a technically qualified Secretary and suitable office staff, it has been found convenient to open a special office in the Ministry of Finance in which is concentrated all petroleum work coming within the competence of the above Committee or otherwise referred to the Ministry.

4.—Petroleum Research.

(i) GEOLOGY.

A careful study of surface geology is necessarily the first step in the systematic search for any mineral. In Egypt the problem is greatly increased in difficulty by the enormous size of the territory to be examined and the lack of transport facilities generally obtaining, difficulties which are greatly enhanced by the paucity of experienced geologists at present available. Having regard to these circumstances and to the fact that the geology of the country was, broadly speaking, either unknown or faultily diagnosed only twenty years ago, the general basis of geological knowledge, which had been collected when

investigations into the petroleum research of the country began to be comprehensively studied, was none the less considerable. The study of the surface geology of the country, however, called both for further extension and for closely detailed supplementary work in connection with the special petroleum investigations. The measures taken and proposed will now be briefly outlined.

In determining the policy of surface geological research, the following factors have been specially kept in mind: (a) the presence of definite seepages of petroleum or the evidence at surface of its former presence; (b) geographical proximity to the great routes of the world's commerce, which both increases marketable value and facilitates transport; (c) as regards the wider investigations, the existence of suitable maps on which the geological data could be recorded.

(a) The *presence* of petroleum in quantity at Hurghada and Gemsa, of seepages at Zeitîa, of shallow oil at Gebel Tanka, and of marked indications of the former presence of oil at Abu Durba and Râs Dîb, all situated on the shores of the Gulf of Suez, clearly indicated that research should be begun along the borders of the Gulf, detailed maps being made of those areas where the indications of petroleum were well marked, while more rapid traverses between these areas added fresh information as to the former distribution of bituminous deposits.

Following this policy, the shore-lines of both sides of the Gulf were studied in the first two seasons (1917-1918 and 1918-1919) on the Sinai side, from Abu Durba to Suez, with detailed examination of Abu Durba and Tanka, and on the Egyptian side of the Gulf between Hurghada and Râs Dîb, with detailed mapping of South Zeit and Râs Dîb. The issue of the reports resulting from these researches has been followed by considerable interest being exhibited by companies in the territory examined by the Government, and by the taking out by them of licences for prospecting areas.

(b) As regards *localities on the main lines of the world's commerce*, it was pointed out in the Government Oilfields Report of Egypt, 1916 (p. 10), that the younger strata of the Gulf of Suez depression extended into the Suez Canal area, and that this region called for earnest investigation. Transport difficulties hindered this being undertaken in 1918-1919, but the research has been carried out in 1919-1920, and definite areas examined and mapped in detail at Shallûfa and Genefe. It is intended to pursue this in the coming season, and to trace the connection between the areas near Suez thus investigated in detail with those whose surface character had been determined during the first season. The aim is to obtain the fullest information possible as to the underground structure of the region adjoining Suez, in so far as it can be determined by surface study with-

out boring operations. It is expected that valuable information as to the character of the strata in depth will be obtained by the operations of companies about to be undertaken in this region, such information being, in accordance with the mining agreements, available to the Government for the general advantage, subject to reasonable restrictions to safeguard rights.

(c) The *existence of suitable maps* has led to the wider investigation being extended into the northern portion of the Peninsula of Sinai, where the 1 : 125,000 maps formed such a suitable basis. This has had the added advantage of giving the first precise information as to the surface geology of this wide region, and, when completed, it will be possible to consider the relations of the oil-containing formations in Sinai to those developed in Palestine.

(d) From time to time the Department of Mines and Geological Survey have in past years visited the coast of the Red Sea south of Hurghada, with a view to obtaining a knowledge of the suitable structures developed in that region, in so far as they could be approached by steamer. The closer examination of this area remains to be done both by traverse and in detail, but the Mureikha Bulletin (*see* § 2), dealing with a region north of Quseir, is a type of the character of study proposed. Briefly, when the investigations outlined in paragraphs (a), (b), and (c) have been carried out, it is intended to extend them into this latter district, in which companies have already been given an opportunity of securing suitable structures for study, of which some have readily availed themselves. The Government has also mapped the region between Desht el Dubha and Safaga in detail on a scale of 1 : 100,000, although the issue of the bulletin dealing with this area has been delayed by circumstances connected with the war.

Turning now to further developments :—

(e) It is proposed to continue the Suez study into the Wadi Ramlia area south of Gebel Ataq, where the strata appear to be identical with those near Suez itself.

(f) To investigate the character of the strata round the eastern point of the southern Galala Range.

(g) To have a special examination of the *inter-gypseous limestones*, wherever these occur in Egypt and Sinai, in order to see whether they display indications of having formerly contained petroleum. These beds are of much importance, because they apparently are those in which the light oils of the Gemsa type occur. This means a study of the gypsum areas from near Râs Gharîb to Halâib, and from thence to north of Port Sudan, if the Sudan authorities would desire co-operation. This may also involve test-

boring at Gebel Zeit (near the seepage) and at Râs Dîb. The oil obtained from the seepage at Gebel Zeit appears to be a residue of the valuable Gernsa crude oil. The bores hitherto undertaken have been on the same line as the seepage. It is proposed to have a boring made down the probable slope of the beds, in order to determine whether the oil-containing stratum can be identified, and, if that be successful, to see whether it be worth while trying to trace its extension southward into the more open ground north of Zeitîa harbour.

(h) A closer examination of the Cairo region in view of the oil-smelling limestones at Batn el Baqara, the indication near Helwân, and the presence of suitable structure (an anticline) near Cairo.

(i) The close connection of petroleum with lignite deposits makes it desirable to investigate the oil possibilities of these carbonaceous shales, whether they occur in the Idfu region, in Wadi Araba, or in Central Sinai or elsewhere. This means, in the first place, a chemical investigation as to oil content. To carry out these studies successfully, in most cases, requires better maps of the areas than are at present available, and they are consequently held over for the moment. The carbonaceous shale question may, however, be put more in the forefront during the coming season, if circumstances permit, and the operations of some of the companies, notably in South Zeit, south of Quseir, and possibly near Râs Dîb, may give helpful information under the heading (g).

(ii) INVESTIGATORY BORING.

In accord with the growth of policy whereby investigations of the Government into the possibilities and origins of petroleum deposits in Egypt have gradually intensified, it was decided in the winter of 1918-1919 that inquiries should be carried below the surface by means of shallow bores. It will be readily appreciated that while a very great deal can be learnt from geological investigations at the surface, knowledge so gained can be greatly enhanced by judicious borings. In numerous places surface evidence of petroleum is found to exist, either in the shape of surface rocks sufficiently charged with petroleum to emit a characteristic odour upon breaking, or containing the residue of evaporated crude oil, or, more rarely, of actual seepages.

The guiding principle adopted was the examination with the assistance of shallow boring of the geological structure of areas in which such physical evidences of petroleum existed. By following up in the light of the information thus gained the structural geology associated with the actual occurrence of petroleum it was hoped to be able to make judicious selections of sites for further investigatory

borings, which would in turn be similarly studied in conjunction with the structural geology. By extension and repetition of the process it is hoped increasingly to accumulate information and thus assist in establishing some assured connection between surface indications, structural geology, and deep-seated petroleum deposits in Egypt. It will, of course, be appreciated that existing surface indications may merely be the expiring remnants of deep-seated deposits which have gradually escaped and evaporated, or that they are merely evidence of superficial accumulations. The importance of thorough scientific investigation of any possibility of local fuel deposits is so great that there is the amplest justification for pursuing these investigations until they are rewarded by definite conclusions even if these are merely negative.

(iii) CHEMICAL STUDY.

The field covered by chemical study is as follows :—

(a) The analysis of samples of crude petroleum taken at more or less regular intervals from all the "producing" wells in Egypt, tabulated records being kept of the variations in the benzine and kerosene contents as well as of the presence and amount of any impurities, such as salt and water. Oil seepages, impregnated rocks, oil shales, and other specimens collected by the geologists in the course of their surveys are also subjected to chemical examination which, as it proceeds hand in hand with the surface exploration and the operation of existing wells, serves as a guide to the best direction for their further development.

The more complicated research problem of the exhaustive chemical examination of the indigenous crude oil has also been undertaken, as a contribution to the general study of the origin, occurrence, and migration of petroleum in the rock strata.

(b) The conditions under which petroleum products are used in Egypt (*e.g.* in boiler furnaces, internal combustion engines, etc.) are being carefully studied. This work includes investigation of cases where the physical or chemical nature of the oil used gives rise to difficulty in working and handling, or where breakdown of plant, accidents, etc., have occurred. In this way precise information is being gathered as to the types of petroleum product which will enable Egyptian consumers to obtain the best and most economical results from liquid fuel.

Such work is in accordance with the recommendation of the Fuel Committee (Report, 1917-1918, p. 30), namely, that "Government specifications should be drawn up defining the quality of all products of crude petroleum to be sold in Egypt, including benzine, kerosene,

and Diesel (fuel) oil, with a view to standardizing grades: a standard grade of fuel for Diesel engines in particular is urgently required."

(c) In the light of the knowledge obtained by (a) as to the nature and chemical character of typical Egyptian crude oils, and of that obtained by (b) as to the precise requirements of Egyptian consumers of petroleum products, chemical research is being carried out as to the best methods of refining such crude petroleum as is, or may be, discovered in the country. The object of refining is the production of the following commercial products: petroleum spirit (benzine), kerosene, solar oil, fuel oil, pitch, paraffin wax, and lubricating oil. The chemical processes used have to be adapted so that the qualities and grades produced are specially suitable for use in this country.

It is important to observe that crude petroleum as obtained from oil wells is never suitable for use in its natural condition. Moreover, it varies enormously in physical and chemical character, ranging from a heavy black semi-solid mass to a light pale yellow mobile liquid. The proportion of liquid products which it contains may lie anywhere between the following limits: petroleum spirit (benzine), *nil* to 50 per cent; kerosene, *nil* to 75 per cent; heavy and residual products (fuel oil, etc.), *nil* to 100 per cent. Various solid products may also be present in widely different proportions, some oils being rich in paraffin wax, while others contain a considerable percentage of hard asphalt. In addition, the crude oil may be water-free, or it may be contaminated with salt and water in the form of an emulsion. Examples of such variations occur not only as between oilfields in different parts of the world, but also between oilfields lying near one another in the same country. Further than this, the different wells of the same field may yield crude oil of varying grades, and even in a single well the quality of the oil may be different at different depths. Cases in point are found in Egypt, where the typical Hurghada product requires different refining treatment from that of Gemsa, and certain of the Hurghada wells, which vary somewhat amongst themselves, are now yielding an oil slightly different from that obtained from them some years ago. Some Egyptian wells also show the salt water emulsions referred to above.

Hurghada crude oils have been taken as the principal basis of experiment for chemical research on refining processes. They are oils which, in virtue of their chemical composition, are difficult to refine fully, and whatever may be the nature of the crude product from fields that may be discovered in Egypt in the future, it is scarcely likely that more troublesome cases will arise.

The experiments made have already reached a satisfactory stage of development and means have been devised for producing from Hurghada crude oil satisfactory grades of the petroleum products

principally used in Egypt. Of these, fuel oil is probably the most important, since it is the one required in greatest quantity, and for this reason special attention has been devoted to it. It is necessary that such an oil should not be too viscous, even at winter temperatures, since this causes difficulty in transport and handling; and it should also be free from asphalt and mineral impurities, such as salt, since these make it unsuitable for use in internal combustion engines.

Mazût (the black residue which remains after the removal of the light fractions from crude petroleum) is still largely used as fuel, but the product as usually obtained from Hurghada crude oil is deficient in both the above-mentioned respects.

In the course of chemical research it has, however, been shown that by subjecting Hurghada *mazût* to treatment which ensures a moderate degree of "cracking," it is possible to obtain in large quantity a thin distillate suitable in all respects for use in internal combustion engines of the Diesel type. Such a distillate can also be mixed with ordinary *mazût* so as to reduce the viscosity of the latter, and a comparatively cheap product is thus obtained which is suitable for burning in boiler furnaces, etc., and which remains fluid in winter.

Trials of the cracking and distillation process are now being made on a semi-manufacturing scale, so that the best conditions for actual large scale work may be determined. The method of treatment which has been evolved causes a partial break-up of the heavier paraffins into lighter ones, so that the percentage yields of lighter fractions (kerosene, etc.) are higher than the proportions present in the crude petroleum in its natural state. This is of interest in view of the recommendations of the Fuel Committee (Report, 1917-1918, p. 29) that :—

"The Hurghada petroleum should be further examined and tested with a view to determining whether the amount of kerosene produced from it cannot be increased without making the residual fuel oil too viscous, or alternatively to find an economical method of reducing viscosity after extracting the maximum quantity of kerosene."

A special difficulty which interferes with the normal refining process arises when the oil contains refractory salt water emulsions. Such cases occur among the Hurghada oils and have been specially studied with a view to devising means of getting rid of the salt before the oil enters the refining plant.

(d) If the geological and mining research should lead to the discovery by the Government of petroleum in quantity, the refining processes described above will have to be put into practice with the least possible delay. The nucleus of a small Government refinery has consequently been prepared, appropriate plant having been selected and a suitable lay-out arranged. The refinery will at first consist only

of " first units," in which a limited quantity of oil can be put through all the chemical processes necessary for its conversion into marketable products. However, the arrangements made are such that each part of the plant can readily be extended, so that within a comparatively short time the Government could increase the through-put of its refinery and deal in a suitable manner with all the oil available.

5.—Deep Boring by Government.

The continued increase in the price of fuel and the continued difficulty in obtaining assured supplies well in advance of actual need, which led the Government in 1917 to undertake a systematic programme of petroleum research in Egypt, caused it in due course to enlarge the scope of its activities still further. In August 1919 it was decided to undertake deep boring operations with a definite view to intensive production, if petroleum in quantity was encountered. The new decision was a radical alteration in policy, since, for the first time, the Government itself embarked upon the extremely hazardous business of petroleum mining, instead of confining itself to attracting private enterprise for the purpose.

The area selected for this attempt was that of Abu Shaar, mentioned below. The considerations leading to the selection of this area were twofold :—

(a) Surface conditions suggesting the probability of deep-seated structures suitable for the collection of petroleum.

(b) The proximity of the Hurghada field, which lies several miles to the south, indicating that petroleum-forming conditions were existent in this part of the country.

It must be clearly appreciated that the prospects of success being met with by Government in its first attempt to find petroleum in quantity are very uncertain. This, as already emphasized, is inherent in the type of enterprise and follows from the general difficulty of determining the origin and occurrence of petroleum, and from the restricted areas within which success has so far attended similar prospecting ventures in Egypt. But the Government's decision to prospect for petroleum must not therefore be thought unwise: it is fully justified by the outstanding need of additional fuel supplies for Egypt and the consequent desirability of supporting any reasonable efforts or expenditure in an endeavour to locate further petroliferous areas. If the Government is fortunate enough to find another oilfield similar to that at Hurghada or Gemsa, its direct possession would naturally be of far greater value to Egypt than if it had been located by a commercial company working primarily for its own profit.

In other words, a venture that would have been justly considered improperly risky in pre-war days, when fuel was cheap and plentiful, is amply justified by altered circumstances.

Apart from consistency of purpose and a readiness to face considerable financial loss if the venture fails, it is necessary that this first mining venture of the Government should be conducted in a sober and a businesslike manner. Moreover, in the event of success, the Government must not be dependent upon any outside body for any stage in the various processes of mining, transporting, refining, and supplying the petroleum and petroleum products. It must consequently have at its disposal the necessary storage tanks, tank-ships, refinery, and pipe lines.

It must therefore be appreciated that there is no prospect of finding petroleum immediately, and still less of producing it in any considerable quantities at an early date. If the deep boring programme is to proceed rapidly and effectively when it is started, it is essential that all the preliminaries should be complete before it is begun. These preliminaries involve fitting up and commissioning a suitable steamer to act as mining camp tender, the erection of a pier, the laying of a railway, provision for storage and transport, the accumulation of the necessary mining material, the erection of houses for camp and staff, and the completion of arrangements for provisioning the camp. In any initial mining venture delays must occur, and the circumstances ruling at present make such delays more prolonged than they were before the war, especially for any body beginning new operations.

The decision to carry out a deep prospecting bore in the Abu Shaar area should not be considered as an extension of the policy of petroleum research explained above, but as an entirely new venture. If dry holes result, the information should prove of great value in connection with the general search for petroleum deposits ; while, should real success be met in a series of suitably placed bores, the period of Government production will have been reached. However, until a definite result is obtained, it is better to look upon the boring operations, whether for purposes of research or for purposes of prospecting, as a combined series of investigatory operations carried out by the Department of Mines. In pursuance of this the Controller of Mines has arranged to constitute a separate section of the Department for the conduct of all petroleum mining research operations. It is essential that this work should be organized and managed as a separate unit, without interchange of personnel, if it is not to react unfavourably upon the administration of the other branches of the Department of Mines. While the Controller of the Department of Mines concurs in the advisability of the Government's action in undertaking the difficult and speculative operation of deep boring, he is most anxious that the enterprise of the Government in this field should be clearly defined

and separated from the normal duties of the Department of Mines in relation to petroleum mining enterprises conducted in other places by commercial companies in Egypt.

6. --Sites reserved for Investigation by Government.

To enable boring operations to be carried out, several areas have been selected and reserved for Government. Among these are the Abu Durba area and the Abu Shaar area, both mentioned above.

The Abu Durba area had previously been held under a petroleum prospecting licence which was abandoned. The Abu Shaar area, in spite of its proximity to Hurghada, was not applied for by the neighbouring or any other company until after the Government had notified mining companies operating in Egypt of its decision to reserve the area for its own investigations. Neither had any company previously intimated any interest in it.

A third area between Suez and the Bitter Lake, which had been noted by the Government as worth investigation in 1918, was reserved a little later. It has since been abandoned in the light of work last season. Several other areas situated in Northern Sinai have also been recently reserved for investigation by the Government as part of the results of the last field season's geological work. While the Government must necessarily maintain its full right to grant or refuse at its discretion applications for prospecting licences made by mining companies, it has so far entirely confined its selection of investigation reserves to areas which have been abandoned by licensees or for which no applications have been received.

7.—Results of First Research Borings.

An outcrop of petroleum-impregnated sandstone at Abu Durba (twenty-five miles north of Tôr) led to the selection of the site for the first shallow research boring. The bituminous character of the area had been known since the Government report made by Colonel Stewart in 1888, in which he recommended that it should be tested by a shallow boring.

The sandstone, containing residues of petroleum, and which is overlaid by shale beds, appears at the surface about 250 metres inland ; from thence it slopes steadily seawards under recent deposits of gravel. The first bore was commenced in May 1918. The particular object of this bore was to ascertain if liquid petroleum existed in the sandstone some little way down the slope of the bed ; it being anticipated that liquid petroleum would be found in the sandstone at no great depth, although the outcrop itself is dry.

The bore was placed about 45 metres to seaward of the nearest point of the outcrop, and passed through the shale beds into the sandstone, confirming expectation by producing liquid petroleum at the rate of one ton a day from beds between depths of 45 and 60 metres.

The second bore, commenced in May 1919, was placed 75 metres to seaward of bore No. 1. The object of this bore was to determine the further extension of the sandstone down the slope of the bed, and to test the yield of petroleum at the new position.

Great difficulty and delay was occasioned by passage through gravels, but the bore had attained a depth of 90 metres in July, when work was suspended. It was resumed in December 1919, but further working difficulties continued to be encountered. The last 36 metres of the bore could not be cased, and as water horizons had been met, it was necessary to plug the bore and await the arrival of plant before testing for quantity of oil. Eventually the bore will be permanently plugged and another drilled in between it and No. 1.

The second bore has confirmed the presence of petroleum (at 162 metres depth), but changes in the strata are indicated which are still indefinite, while the sandstone has not yet been recognized. Boring will be carried on until the investigation is completed and will be maintained as long as appears justified by the production of the wells. The supply in No. 2 is expected to be greater than that obtained in No. 1, and as regards quality, there are indications of a slight improvement as the depth increases. So far, however, the oil has all been of a low grade, about equal in quality to the residue or *mazût* obtained from Hurghada crude oil by denuding it of petroleum spirit and kerosene. Nevertheless, it is hoped that within a comparatively shallow depth the results obtained, both as regards quantity and quality, will justify development and provide a small field capable of paying its way in spite of slight production, on account of the low cost of the shallow drilling entailed. Although the object of investigatory boring is to obtain information rather than supplies of oil, production of oil will, of course, always be proceeded with if it is found under conditions justifying economic development.

8.—Internal Criticism of Government's Policy.

In the beginning of this note an attempt has been made to explain briefly the principles underlying the pre-war policy of the Egyptian Government with regard to petroleum mining in Egypt. The hazardous character of petroleum mining in general was explained, and also that competent opinion all the world over is united in considering that under normal circumstances public money should not be risked on enterprises of so uncertain a character.

The alteration in the world's fuel position, however, gradually caused this Government, as others, to reconsider its practice and led it initially to widen its programme of research into the origin, character, and occurrence of petroleum in Egypt, and subsequently to undertake prospecting for petroleum in quantity itself.

After a prolific field had been proved at Hurghada, and as prices of fuel began to rise all over the world, the Government began to be subjected to considerable local criticism because of the large profits made by the operating company, and on the grounds that the Government should have retained the working of the field in its own hands. Such criticism is based upon ignorance of past history and of the uncertainty that prevailed, even a short time ago, as to whether petroleum existed in Egypt at all in any useful quantity.

At that time the Government would not have been justified in sinking considerable public funds in a doubtful venture for petroleum, and the only other alternatives were either to abandon the search or to encourage private enterprise to undertake it. But private enterprise can only be encouraged to undertake a risky enterprise by an assurance of exceptional profits in the event of success, and in such event it is neither reasonable nor just only to remember the present advantage and to forget the risks of total loss previously run.

If the search for petroleum in Egypt had not been undertaken by private mining companies, it would not have been undertaken at all, and Egypt would have missed the considerable additions to her fuel imports which the Hurghada field provided so opportunely during the war, and which it is still continuing to provide. Nor has the advantage been only in regard to supply, for, under its agreement with the Government, the company operating at Hurghada was under an obligation to sell both kerosene and liquid fuel (*mazût*) produced from Egyptian oil at prices much below those generally ruling throughout the world. There is not nearly enough petroleum produced at Hurghada to supply the needs of the country (*see* Plate I), and consequently the cheap local *mazût* can only be obtained by a limited few. In the case of kerosene a flat rate is settled periodically by agreement with the Government to include kerosene imported from abroad, which it will be seen is much the larger proportion at present.

9.—External Criticism of Government's Policy.

External criticism of the policy of the Government has in the past been primarily directed against the limitation of prospecting areas allowed to mining companies, and to the refusal of the Government to acquiesce in a monopolistic position being attained by any particular group.

Experience has fully justified the policy of the Government in both these respects and in both it is strongly supported by local opinion. The areas accorded under licence for prospecting purposes have been ample for the purpose, while the Government has always been ready to modify its regulations in this as in other matters when it was satisfied that good cause had been shown. But the Government has throughout maintained the greatest objection to considerable tracts of unexplored territory being sterilely squatted on by mining companies on the plea that these untested areas provided hypothetical petroliferous reserves.

On the other hand, it is quite comprehensible that the recent decision of the Government to undertake prospecting itself has awakened a certain suspicion and uneasiness among mining companies already engaged in the search for petroleum in Egypt. It has been suggested that the advent of the Government in the prospecting field limits the already limited territory available for investigation and that if the Government is seriously entering the petroleum mining field it will retain all the best areas for itself and reduce to negligible dimensions the prospects of success for others. While superficially plausible, nothing could really be further from the truth. In a recent lecture before the Royal Society of Arts,* Sir John Cadman justly emphasized the infinitesimal portion of the geologically promising areas of the earth's crust that has yet been thoroughly examined for petroleum products. Egypt is an instance of such an area and the Egyptian Government will require all the assistance it can attract for decades ahead properly to examine its own wide extent of territory, a territory which it is not generally realized is equivalent in area to France and Germany combined.

Not only will the Egyptian Government's policy not operate to restrict the area and opportunity for petroleum prospecting, but, if properly applied, it will widen and extend both, and has indeed already done so. The future of petroleum development of the world's resources lies with scientifically conducted comprehensive enterprise. Enlightened mining companies are doubtless turning more and more to scientific workers and methods, but one of the most striking features of twenty years of petroleum mining in Egypt has been the absence on the part of any mining company of a well-equipped and scientifically conducted endeavour to widen the prospecting field. This gap is now being filled by the Government's own research organization, and if this continues to be manned and directed by competent scientific and technical staff, it will gradually explore the whole extent of Egyptian territory in advance of, and in preparation for, subsequent prospecting, whether conducted by the Government itself or by mining companies.

* "Journal of the Royal Society of Arts," July 30, 1920.

This will be greatly to the common advantage. The Government in the course of its research operations will mark down certain reserves for its own investigation, but the total area it can itself undertake thoroughly to prospect in any reasonable time is necessarily closely limited, while its research operations will gradually throw increasing light for the advantage of all upon the localities and conditions most favourable to the occurrence of petroleum throughout Egypt.

Nor is the comprehensive sweep of preliminary geological investigation conducted by the Government research parties intended to exclude mining companies from obtaining a temporary right exclusively to study a given district with a view to the eventual choice of sites therein for prospecting. Special "Exploration Permits" have indeed been provisionally issued this season at the suggestion of mining companies with respect to definite specified districts: these allow applicants adequate opportunity to examine the surface geology of the neighbourhood and to select prospecting areas therein, unhampered by the attention of all competitors.

10.—Present Policy of Government.

The present policy of the Government may consequently be broadly re-stated under three heads: firstly: (a) co-ordinated scientific investigation into the character, origin, and occurrence of petroleum in Egypt, conducted by a permanent research organization of the Government; secondly (b) deep borehole prospecting by the Government in certain selected areas; thirdly (c) the continuation throughout the remainder of the country of the existing procedure whereby companies are allowed to take out standard petroleum mining agreements.

Egyptian opinion still displays considerable hostility to, and suspicion of, foreign companies, chiefly on the grounds that they have often acquired a monopolistic position and have made unduly large profits. This is not the place to discuss whether such companies have occupied an unduly privileged position generally, although it is self-evident that they have been an essential factor in the general advance of wealth and well-being. It is, however, of the first importance to the country that Egyptian opinion should realize that the aid of a certain number of first-class mining companies is indispensable if an exhaustive search for petroleum is to be conducted throughout Egyptian territory. Doubtless the benefits accruing to the country if a mining company finds petroleum are not so great as if it is found by the Government itself, but the benefits are none the less very considerable. Moreover, it is infinitely preferable that petroleum should be found by mining companies operating in Egypt than that

its discovery should be long postponed or should not take place at all. The standard petroleum mining agreements of the Government are designed so as to secure to the Government a fair and reasonable share in any successful petroleum mining venture, having full regard for the risky character of all such enterprises. As knowledge grows with regard to the localities and conditions most favourable to the occurrence of petroleum in Egypt, the share of the Government in the event of success can properly be, and indeed has already been, advanced. A table of petroleum mining royalties imposed in Egypt and those in force elsewhere is attached. It is, however, far more important to attract companies of good standing and reputation than to enforce strict terms, since it is better to take a moderate proportion of benefits than to jeopardize the chance of success further by ineffective or dishonest management.

APPENDIX I.

PETROLEUM ROYALTIES.

Egypt.

DATE.		
1905 to 1910	Crude oil (per 100 gallons) ...	P.T. $2\frac{1}{2}$, approximately equivalent to <i>ad valorem</i> :— 5 per cent in 1905. $1\frac{1}{2}$ per cent in 1920.
1910 to 1920	Petroleum crude products (<i>ad valorem</i>).	5 per cent minimum. $7\frac{1}{2}$ per cent mean. 10 per cent maximum.
1920	Petroleum crude products (<i>ad valorem</i>).	$12\frac{1}{2}$ per cent for unproved land. Up to 25 per cent for proved land.

NOTE.—Royalty is offset against “dead” rent.

Under the present standard form of agreement Royalty may be taken either in kind or in cash at Government option. The Government has also the right of pre-emption over a quantity of the oil not exceeding 20 per cent of the previous year's output.

Some other Countries.

United States of America ...	From $12\frac{1}{2}$ per cent to 25 per cent for high-grade crude oil. From $12\frac{1}{2}$ per cent to 20 per cent for inferior crude oil. The sliding scale is based on quantity produced. The most usual royalty is $12\frac{1}{2}$ per cent.
Russia	By auction, tenders vary from 25 per cent to 70 per cent. Royalty decreases in some cases with augmentation of output.
Roumania	By negotiation, average 10 per cent <i>ad valorem</i> and a Government export tax.
Galicja	From 6 per cent to 22 per cent.
Trinidad	2/- per ton or 10 per cent <i>ad valorem</i> .
Burma	5/- per ton or from 5 per cent to 10 per cent <i>ad valorem</i> .
Persia	16 per cent of profits.

NOTE.—The Canadian Government pays a bounty of $1\frac{1}{2}$ cents per imperial gallon on all crude oils produced or put into storage in Canada,

APPENDIX II.

TABULAR STATEMENT OF HISTORY OF PETROLEUM RESEARCH AND DEVELOPMENT IN EGYPT.

The following tabular statement is compiled from the files and personal notes of the Department of Mines and Geological Survey respectively. As much weight as possible has been given to work undertaken by Companies, but, as their records are not published, they may have undertaken exploratory research of which the dates and extent are not known.

THE HURGHADA—ABU MINGARH AREA.

YEAR.	GOVERNMENT ACTION.	COMPANIES' PROCEEDINGS.	REMARKS.
1886	Mr. L. H. Mitchell went on reconnaissance under Government instructions to Petroleum Districts. Jifatin and Shadwan, as also the principal islands (Jubal, etc.), were placed outside the limits of practical research, most of them as having oil at too great depth. The north-west extremity of Gebel Zeit and Bîr Abu Shaar mentioned as most promising localities for boring. Also in the Great Plain, in Wâdi Dîb, and neighbourhood of Bîr el Melaha. Mr. Mitchell was seeking for the oil in a Devonian formation similar to that in America.		Mr. Mitchell remarked ("Report on Râs Gemsah and Gebel Zeit," p. 47): "The tract of country traversed from Gebel Abu Shaar to Abu Mingarh, although belonging, geologically, to the same periods as the country between Gebel Abu Shaar and Gebel and Râs Gharîb, presented no indications of petroleum. This fact is, nevertheless, no proof that it does not exist in that region in the depths below; for, on the one hand, there may exist intrusions of igneous rocks causing oil indications which were not discovered; and, on the other hand, there may have been no intrusions necessary to the fissuring of overlying strata so as to permit either petroleum, or its oils and gases, to reach the surface."

1887

Colonel Stewart (under instructions from Under-Secretary, Ministry of Public Works) made a wide study, but does not appear to have visited this region.

1898

Mr. Barron noted the oil-rock at foot of Red Sea hills west of Desht el Dubha, but did not come down to the sea-coast.

1899-1908

Neither Dr. Wanner (1899-1900) nor Mr. Wells ("Report to African Prospecting Syndicate," 1908) mention the Hurghada-Abu Mingarh region.

If either Dr. Erb or Mr. Bauerman made any reports, these were not divulged to the Department of Mines.

1907
(April 23)

At this date the Cairo Syndicate obtained coal and oil prospecting licences for Areas No. 23 (Jifatin), No. 24 (Abu Mingarh, including Hurghada), No. 25 (Black Hill), and No. 26 (Abu Shaar).

1909

In December 1909, Mr. Dowson Director-General, Survey Department, in letter No. 26163 to Director, Geological Survey, laid down a general outline for survey of the Red Sea oilfields, this including mapping, topographical and geological, on 1:100,000 scale, and study of geology of district to obtain information, if possible, as to presence and location of petroleum.

1910

Date of letter from Mr. Devonshire applying for Abu Mingarh area: November 25, 1910.

1911

On April 1, 1911, Egyptian Oil Trust took up Abu Mingarh (excluding Hurghada) and Jifatin (on March 3,

See Barron and Hume, "Eastern Desert of Egypt," p. 180.

Dr. Erb went over the Gemsa-Zeit area with Mr. Wells, and Mr. Bauerman travelled a good deal in the oilfield country, but there is no evidence that either of them visited Hurghada-Abu Mingarh.

The map of areas applied for is in Mines File of Plans, OL. I/h, and is signed by Mr. Earle Trevor, April 1907, who evidently visited the areas. No geological reasons are given.

In the course of the 1911 expedition, Dr. Hume noted the oil-rock of North Hurghada. This was recorded on

THE HURGHADA—ABU MINGARH AREA (*continued*).

YEAR.	GOVERNMENT ACTION.	COMPANIES' PROCEEDINGS.	REMARKS.
1911	map from 1909-1911, and Dr. Hume studied the geology in 1910, 1911, 1912, and 1913.	1911). Apparently the Egyptian Oil Trust applied for most of the areas held previously by the Cairo Syndicate (1907-1909), but were only granted the two mentioned above. They showed no special interest in securing either Hurghada or Abu Shaar areas.	1:100,000 map used. In Geological Survey notebook under date March 28, 1911; also recorded in private diary of that date. On March 13, 1911, Mr. Burls asked Dr. Hume to accompany him on "Port Tewfik," as latter was unable otherwise to obtain passage. Together they visited Jifatin and Abu Mingarh. Not being free to give information, Dr. Hume did not mention the occurrence at Hurghada to Mr. Burls. They afterwards visited Abu Shaar and Abu Durba together. In the new arrangements made about areas, the minor ones adopted did not include Hurghada.
1912	On May 1, 1912, Sir Paul Harvey and Mr. Dowson visited Gensa, and the latter gave Dr. Hume freedom to discuss matters more freely with the incoming manager, Mr. Hoorweg. After talks about policy with latter on May 4 to 7, Mr. Blyth, of the E.O.T., accompanied Dr. Hume on a visit to Abu Mingarh, etc. On May 9, 1912, the party visited Hurghada and examined oil-rock. Also visited Jifatin, Little Jifatin, and Desht el Kora.	The Anglo-Egyptian Oilfields, Ltd., took up Abu Mingarh, Desht el Kora, and Jifatin on April 1, 1912. Continued a year, and then this licence was replaced by the 1913 agreement.	
1913	Dr. Hume was recalled from Gensa early in January to meet Professor	Drs. Wanner and Schurmann, examining areas on behalf of A.E.O., went	

out on same steamer as the Mrazec-Hume party. On May 28, 1913, Dr. Wanner presented to the Company a valuable and detailed report on the Hurghada area, which was the basis of the Company's operations.

Mrazec, come out by invitation of the Government, to examine the oilfield region with Dr. Hume. Party left Suez on January 29, 1913. On February 9, 1913, the party reached Abu Mingarh, and studied Hurghada together on February 11 and 12. Mr. Murray left at Abu Mingarh, preparing 1:10,000 map both of Abu Mingarh and Hurghada. The Mrazec expedition closed on March 23, 1913.

The broad conclusions of this analysis seem to be, so far as can be traced by documentary evidence:—

- 1886. The first record that this area was of possible oilfield importance was made by Mitchels's Government expedition.
- 1907. (April 23.) Cairo Syndicate took out four areas covering the Hurghada one. Mr. Earle Trevor was the mining engineer signing the documents.
- 1911. (March 28.) The oil-rock of Hurghada first noted by Dr. Hume during 1911 Government geological survey of area.
- 1913. (May 28.) Dr. Wanner presented report to A.E.O., which determined their boring operations at Hurghada.

ABU SHAAH AREA.

YEAR.	GOVERNMENT ACTION.	COMPANIES' PROCEEDINGS.	REMARKS.
1907 (April 23)		<p>The Abu Shaar area was first defined in the application of the Cairo Syndicate for a coal and oil licence. Licence lapsed on May 23, 1909.</p>	<p>The map of the area is in the Mines File of Plans, OL. I/h, and is signed by Mr. Farle Trevor, April 1907.</p>
1911	<p>In 1911 Dr. Hume crossed this area on the way to Hurghada, and made notes on the geology, but no special structures were recognized.</p>	<p>In 1911 the Egyptian Oil Trust applied for this, in addition to the other areas above, but were only granted licence areas at Abu Mingarh and near Abu Shaar.</p>	
1918	<p>The programme of work laid down for the Petroleum Research expedition by Geological Survey, No. 341/18, of November 11, 1918, was :— (1) To map the surface geological features of the Hurghada-Abu Mingarh anticline. (2) To extend the examination north-westward, where the beds show the structure less conspicuously, and then to work on to Zeitia.</p>	<p>No information or application came in from any company in connection with this area.</p>	<p>The Petroleum Research plan for 1918-1919 was to begin with a study of the area between Faied and Suez, but owing to unreasonable camel prices the plan was changed and the southern research begun first.</p> <p>Private letters from the Petroleum Research expedition reached the Director, Geological Survey, that a number of interesting domes had been located in the expanse between Hurghada and Abu Shaar, but plans having been made for Dr. Hume to join the party at Zeitia for the mapping of South Zeit and Râs Dîb, it was decided to postpone the Abu Shaar examination till later. In the correspondence this area is referred to as North Hurghada, Abu Shaar may usefully replace it.</p>

The Petroleum Research expedition started work in Abu Shaar area on March 26, 1919, and as a result of its work six *domes* were mapped and geologically examined.

THE GEMSA AREA.

(The name variously spelt Jemsa, Gamsah, etc., but from original Arabic Dimsha),

YEAR.	GOVERNMENT ACTION.	COMPANIES' PROCEEDINGS,	REMARKS.
1863		Petroleum apparently first found here by the Société Soufrière when mining for sulphur. (See Mr. Barois, <i>Rapport sur les Recherches du Pétrole de la Mer Rouge.</i>)	First discovery of surface oil.
1885	The Egyptian Government decided to study this area. Mr. de Bay appointed for the work.		
1886 (May 6)	Colonel Ardagh reported two wells drilled by Mr. de Bay, in first of which oil supply reached at depth of 106 feet, yielding 25 barrels a day. Second bore struck oil at 137 feet. Flow estimated at 500 cubic metres a day, of which one-third oil, rest water.		First indication of underground oil.
1888	Egyptian Government having expended L.E. 100,000 without result abandoned enterprise. Colonel Stewart, in his report to Government, gives general results to date, but finding of light oil in boring not mentioned.		
1898	Mr. Barron, of the Geological Survey, recognized Gemsa as a breached anticline, but was not favourably impressed with the possibilities of petroleum in commercial quantity.		

First action by private Company.

Mr. Rushton applied for a large concession, which included Gemsa.

Mr. Lebeau, the engineer who drilled the de Bay wells at Gemsa in 1886, satisfied the promoters of the Egyptian Petroleum Company, Ltd., that oil existed at that locality, and a licence was duly issued to them in April 1906. Messrs. D. A. Sutherland and D. A. Louis made a favourable report.

No. 1 well begun on January 1, 1908, and drilled in successfully to oil in March 1909. Produced intermittently for four years.

First well drilled in successfully by Egyptian Oil Trust, Ltd.

Well No. 2 begun in March 1909, drilled in April 1910. Had produced 28,000 tons by March 1914.

Rights of licence assigned to Red Sea Oilfields, Ltd.

Nineteen other wells drilled, of which seven produced flows of varying magnitude between 1909-1914.

Rights acquired by Anglo-Egyptian Oilfields, Ltd.

Mr. John Wells, Inspector-General of Mines, arranged for the uncovering of No. 1 well, in which was found an oil of 0.915 sp. gr. with a steady stream of gas rising through it. This indicated that the expenditure of large sums in trial boring was a legitimate venture.

Mr. D. Home appointed Inspector under Captain Lyons, Director, Survey Department, to watch borings for Geological Survey.

Collection of boring samples began from this date. Department of Mines has kept records and followed the progress of the industry continuously from its inception.

The oilfield area mapped on a scale of 1:100,000 and specially of Gemsa headland on 1:10,000 with 5-metre contours and geology between 1909-1911.

1905

1906

1908

1909

1910

1912

THE GEBEL ZEIT AREA (SOUTHERN END).

(The region more particularly referred to is the one covered by Petroleum Bulletin No. 7, now being issued.)

YEAR.	GOVERNMENT ACTION.	COMPANIES' PROCEEDINGS.	REMARKS.
1863		A boring found by M. de Bay in 1885, presumably made by the Société Soufrière in 1863. This was over 25 metres deep.	The oil seepage at Gebel Zeit (<i>Mons Petroleus</i>) was known at least as far back as Roman times.
1885	The Egyptian Government decided to study this area. M. de Bay appointed for the work. See M. Barois, <i>Rapport sur les Recherches du Pétrole de la Mer Rouge.</i>		
1888	Colonel C. E. Stewart, "Report on the Petroleum Districts situated on the Red Sea Coast," 1888, reported abandonment of well near oil seepage (began in 1886) at 706 feet in consequence of reaching crystalline rocks.		
1898	Area examined by Geological Survey (records in Barron and Hume, "Topography and Geology of Eastern Desert of Egypt, Central Portion," 1902). Conditions regarded as unfavourable for petroleum. First geological map made.		
1910		Bore No. 1 (Egyptian Oil Trust, Ltd.) begun near surface seepage in September 1910, and carried to depth of 610 feet, when abandoned, meeting igneous rock.	

1911

Two more bores begun north of Zeitia, April 1911; closed down March 1912.

1912

Drilling began June 1912, at southern end of Zeit peninsula. Abandoned at 1,322 feet, when granite was stated to have been met.

1913

No. 4 bore started on *west* side of Zeit range early in 1913, carried to 1,193 feet, when entered Nubian sandstone with strong supply of water.

1919

The South Zeit area studied by Petroleum Research party. Results published in Petroleum Research Bulletins Nos. 7 and 8.

THE GEBEL ZEIT OR RAS DIB AREA (NORTHERN END).

(The region more particularly referred to is the one covered by Petroleum Research Bulletin No. 8.)

YEAR.	GOVERNMENT ACTION.	COMPANIES' PROCEEDINGS.	REMARKS.
1887	Mr. Mitchell and Colonel Stewart visited Râs Dîb, noting presence of petroleum-smelling limestones near that spot smelling of gas (<i>see</i> Colonel C. E. Stewart, "Report on the Petroleum Districts," p. 14). A spot for drilling was suggested.		
1910		Boring was begun late in 1911 by the African Prospecting Syndicate to the north-west of Râs Dîb, near where Wâdi Dara enters the sea. It was carried to over 3,000 feet, and further progress was prevented by the outbreak of war in 1914.	
1919	Visited by Government research parties in 1912 and 1913, but main study in 1919 by Petroleum Research party, the results of which appear in Petroleum Research Bulletin No. 8.		
1920			Oilfields of Egypt, Ltd., established to carry on work of African Prospecting Syndicate, suspended in 1914, and for new development in this area.

PETROLEUM RESEARCH IN GULF OF SUEZ ISLANDS.

- 36 -

YEAR.	GOVERNMENT ACTION.	COMPANIES' PROCEEDINGS.	REMARKS.
1910	During the progress of the boring the island was visited by members of the Department of Mines and Geological Survey, samples of the strata passed through being also obtained from the Company for inclusion in the Geological Museum records.	<p><i>Gaysum Island.</i></p> <p>Two borings were commenced here in March and April 1910 by the African Prospecting Syndicate. The results indicated the wide extension of the salt series, which, commencing at 450 feet below the surface, continued alternating with shales and gypsum to the bottom of the borings, the deepest of which was 2,668 feet.</p> <p><i>Mulhaimet Island or Um el Heimet.</i></p>	<p>The reason why this area was selected for boring was the apparent anticlinal character of the island. There were no surface indications of oil-smelling rocks on the island itself.</p> <p>The main features of the borings were :— (a) Presence of a series of salt zones. (b) The alternation of these with gypsum and clay, especially the latter. (c) Presence of granitic sands from 1,280 to 1,710 feet.</p>
1910	Do.	As soon as Gamsa mainland began yielding successful results, this island lying opposite very naturally attracted attention. Boring was commenced by the Egyptian Oil Trust on June 27, 1910, and carried down to a depth of over 1,800 feet. Slight indications of oil were recorded in the bore, but no definite results obtained.	
1912	Do.	<i>Ranin Island (near south end of Gebel Zei).</i> Drilling begun here in October 1912, and carried to a depth of 1,500 feet.	Main formations a great series of clays with gypsum and considerable thickness of salt from 540 to 1,090 feet.

1888

Colonel Stewart ("Report on the Petroleum Districts situated on the Red Sea Coast," pp. 22, 23) mentioned Jubal Island as a place for a trial boring, oil being found floating on the sea. He also records it as found at two points on the island itself, one on the north coast and one on the west coast of the island.

1910

Several visits were paid to the island during this period by members of the Department of Mines and Geological Survey, including one with Professor Mrazec.

Samples were collected and notes made, these being now preserved in the Geological Museum at Cairo.

Drilling was begun by the Eastern Petroleum Company in June 1910. No. 1 bore was carried to 1,183 feet and No. 2 bore to 1,575 feet. No. 3 bore (begun in December) reached a depth of 1,625 feet.

The earlier borings near the upper portion of the dome were of interest, because after traversing the gypsum they entered dolomitic beds containing petroleum.

The latter was unfortunately not met in commercial quantity, and when passed through, red granite was entered.

1911

Bore No. 4 begun in November 1911, and carried to 1,317 feet.

1912

Bore No. 5 begun in June 1912, and carried to 1,808 feet.

1913

Bore No. 6 begun in January 1913, and carried to 965 feet. No further work has been undertaken since 1914.

Shadwan, Jifatin, Little Jifatin, and Towila Islands have been visited both by members of the Government Departments above-mentioned and by members of the Companies. The young stratified rocks forming the surfaces give no indications to the existence of oil underneath. Jifatin has long been held under prospecting licence and drilling has just commenced.

PETROLEUM POSSIBILITIES OF AREA OF EASTERN DESERT BETWEEN RED SEA HILLS AND GULF OF SUEZ.

(Other than Zeit and Jemsa already considered.)

YEAR.	GOVERNMENT ACTION.	COMPANIES' PROCEEDINGS.	REMARKS.
1887	Mr. Mitchell, "Râs Gamsah and Gebel Zeit," p. 41, reported the existence of oil-rock near Bîr Abu Shaar, also near the foot of the Middle Saddle, in the Gebel Esh range.		
1908	Mr. John Wells noted presence of anticline at Râs Bahar.		
1909-1910	Dr. Ball and party working on map of oilfield area between 1909-1911, and Dr. Hume studying geology from 1910-1913. Oil-rock at surface recorded by latter east of Gebel Gharamuli (Hume, "Oilfields Region of Egypt," p. 80) and at various points along western slopes of Esh range.	African Prospecting Syndicate commenced drilling at Râs Bahar on February 23, 1910, the deeper bore No. 1 being carried down through gypsum, shale, and salt to close on 3,000 feet. Two small borings were undertaken on sea-coast east of Esh range, but in neither case were the superficial gravels passed through.	
1920	The Egyptian Government is pursuing a definite policy of study, extending its operations, so far as time and staff permit, from the known to the unknown. It has in view a closer examination of the area lying near the Gulf of Suez between Gebel Ataka and the northern and southern Galala ranges, as well as the north-western flanks of the Red Sea hills.	Companies have shown interest recently in the Gharamul area, but drilling operations have not yet commenced. In these last two years representatives of several companies have examined the country adjoining the Gulf of Suez.	

PRELIMINARY EXAMINATION OF RED SEA COAST ESPECIALLY THE DOME STRUCTURES VISIBLE.

1915

A preliminary examination was made by Messrs. Greaves and Hume in the s.s. "Managem," wherever the coast could be approached by steamer. Were visited in turn: St. John's Island, Râs Benas, Ranga Gypsum area, Sherm Sheikh, Wadi Imbarak area. After Messrs. Dabell and Little joined the party, visits were paid to the Qaleb Dome, Um Lassaf gypsum area, Wadi Wizr, Abu Hamrawein. In same year Mr. Little mapped on 1:100,000 and examined the geology of the area between Safaga and Desht el Taba from the sea to the foot of the igneous hills, the characters of the Saadan Dome and the one at Desht el Taba being specially noted. The possibilities of harbour accommodation were kept in view by Captain Morewood, of the "Managem," during these expeditions.

1918

One of the domes north of Quseir, that of Wadi Mureikha, studied in detail, and results published as Bulletin No. 5 of Petroleum Research series.

1919-1920

The notes made in the Government expeditions have not hitherto been published. It may therefore be stated here that the strata consist of a coral limestone (resting on the igneous rocks) capped by gypsum, and this again by stratified fossiliferous formations. They all have a marked dip eastward towards the sea, near which they are frequently thrown into anticlines or domes of striking appearance.

Oil-rock was noted on low ridges in front of gypsum hills at Ranga, also between Um Rus mine and the sea, and the strongly smelling limestone westward of Desht el Taba dome were noted by Mr. Barron during the Geological Survey expedition in 1898, and noted in Barron and Hume, "Eastern Desert of Egypt," 1903, page 180.

The information regarding the Safaga -Desht el Daba was passed on to inquiring companies, as the war had delayed the proposed publication of results. Drilling in this area has not yet begun.

Companies began taking a keen interest in the region south of Quseir, it being taken up for study in the form of exploratory areas. No drilling operations have yet been commenced.

ABU DURBA, WEST SINAI COAST.

(The region more particularly referred to is the one covered by Petroleum Research Bulletin No. 1, now in preparation.)

YEAR.	GOVERNMENT ACTION.	COMPANIES' PROCEEDINGS.	REMARKS.
1889	Colonel Stewart, in January 1888, learnt that petroleum was repeatedly found floating at low tides on the sea at Abu Durba. Mr. Mitchell examined area on his request, and found bituminous sandstones at this spot) see Stewart, "Report on the Petroleum Districts," p. 20).		
1898-1899	Exposure visited by Mr. Barron, who collected samples.		
1907	Mentioned by Mr. Barron in his memoir on Western Sinai.		
1911	On April 13, 1911, Dr. Hume visited Abu Durba with Mr. Burls.		The visit of Mr. Burls for the Anglo-Egyptian Oil Trust is the only evidence available of any Company action at this spot.
1913	Visit with Professor Mrazec, Messrs. Greaves, Dabell, and Little, when interest of area further confirmed.		
1918	Declared Government reserve, studied and mapped by Petroleum Research expedition. Results to appear as Petroleum Research Bulletin No. 1.		

1918-1920

Borings commenced by Department of Mines, first, shallow geological test bore which proved oil to be present, and since, deeper bores for test of quality and quantity.

PETROLEUM RESEARCH IN WESTERN SINAI.

(Other than Abu Durba.

YEAR.	GOVERNMENT ACTION.	COMPANIES' PROCEEDINGS.	REMARKS.
1898-1899	Barron noted the presence of hydrocarbons in Tayiba district at contact of dyke with limestone, and recorded them in his memoir on "Topography and Geology of Western Sinai."		
1907			1868. H. Baerman ("Quarterly Journal, Geological Society," February 1869.—Note on a geological reconnaissance made in Arabia Petræa in 1868") noted the existence of extremely bituminous limestones between the lower end of Wadi Gharandel and Hammam Farafûn, as also southward and eastward of the latter locality. The bituminous limestones contain the well-known Eocene fossil <i>Nannulites Gizehensis</i> and samples near Gharandel yielded 10 per cent carbonaceous matter.
1910-1913		First Boring Operation in Sinai. Owing to oil seepages being noted on the shore near Gebel Tanka, north of Abu Zenima, boring for oil was commenced in August 1910, at that locality. Three borings put down, but abandoned for lack of capital. The most northerly of the three, the deepest, being carried down to a depth of 2,930 feet, traversing the cretaceous strata and entering the Nubian sandstone.	
1916	Ball ("West-Central Sinai," p. 204-212) reviewed the history of the occurrence of petroleum at Gebel Tanka and recorded oil marls at Etla el Zur, in the upper reaches of Wadi Abu Qada.		The Gebel Tanka area was mapped by Mr. Sara for the African Prospecting Syndicate. Also visited by Dr. Schürmann on behalf of the Anglo-Egyptian Oil Company, Ltd.
1917-1920	Gebel Tanka area examined and mapped in detail by Petroleum Research party. Published as Petroleum Research Bulletin No. 4, 1920. Coastal zone of Western Sinai examined early	Between 1919-1920, prospecting licences taken up by companies at numerous localities, but as drilling not yet begun, these cannot as yet be referred to in detail.	

in 1918, from Abu Durba to Suez.
Petroleum noted at Gebel Nezzazat
(results in Petroleum Research Bulletin
No. 3), Abu Zenima, Wadi Nukhul,
Hamman Faraün, and in the Useit-
Gharandel area.

APPENDIX III.

RESEARCH FOR COAL IN EGYPT.*

Owing to the scarcity and high price of coal, the question of the possibility of its existence in Egypt has again been revived, and it is therefore of interest to recall the history of the various attempts which have been made from time to time to discover seams of economic value.

The earliest researches for coal were undertaken as far back as the time of Mohammed Ali Pasha, Figari Bey in 1844 sinking shafts at the village of Ridiſiſya, near Idfu, and at the Bîr el Fahm, near Cairo, both efforts being unsuccessful. At Ridiſiſya a series of clays with thin veins of bituminous material and carbonized plant remains or lignite were met with between 53 and 76 metres below the surface, but from that depth onward to the bottom, 258 metres below surface, no further carbonaceous clays were encountered, the beds passed through being alternations of ordinary-clays and sandstones.

The negative results obtained by Figari Bey were not considered as conclusive, and from 1903 to 1906 several companies undertook prospecting work by boring in Upper Egypt. The only results of these efforts were to emphasize the fact that while carbonaceous matter was widely distributed in a group of clays of definite geological position, it was never in sufficient quantity to form a true seam of coal, or to constitute a workable deposit. Further research has established the widespread distribution of the carbonaceous clays throughout Egypt and Sinai. Thus they were met with during boring operations near Dongola in the North Sudan, and at 'Ain Yesîn, in Khârga Oasis. They have been traced from the west bank of the Nile at Idfu for many kilometres into the Eastern Desert, reappearing on the shores of the Red Sea at Quseir, and in borings for petroleum both on the Red Sea and Sinai coasts. They have also been noted in Sinai itself at several points widely removed from one another, for instance, in the upper valleys of Wadi Gharandel in the west and Wadi Zelega in the east. They are present in Wadi Araba to the north, on the western or Egyptian side of the Gulf of Suez.

In all these cases the carbonaceous clays have been found to be at the same geological horizon, the uppermost portion of the Nubian sandstone formation, which on the evidence of the fossils is proved to be Upper Cretaceous in age.

* By R. H. Greaves and W. F. Hume.

Many of the surface occurrences have been carefully examined by tunnelling into the hills (as in East Sinai) or by borings, but whether the trials were made on behalf of the Government or for companies, the conclusion has always been that in no place known in Egypt or Sinai is there coal of sufficient thickness to be of any value.

When the war began in 1914, representations were made to the Egyptian Government as to the possibilities of these deposits yielding sufficient coal to assist in meeting the general scarcity of fuel. A re-examination was made of the localities in which these beds were best developed, the Department of Mines reopening the old shafts at Ridisya and Abu Rahal, while the Geological Survey re-examined the desert areas between Idfu and Baramia, and also along the borders of the Nile, this including the sinking of a new shaft at Idfu.

The final result of these investigations fully confirmed the negative Idfu conclusions previously arrived at. Such minor deposits of coal as exist in Egypt have been derived from the carbonizing of leaves which were obviously floating seaward, and deposited on the sea-bottom with the finest clayey material derived from the erosion of the mainland. They are not due to changes in vast masses of vegetation growing on the spot where the coal is now found, such as has determined the formation of workable coal deposits elsewhere.

The only possibility would be for there to have been circumstances where there was sufficient concentration of vegetable matter without an intermixture with clay, such as has determined the formation of coal in other countries. Such conditions might conceivably exist to the northward, the continent from which the clay and coal-producing vegetable matter were derived having, so far as our present knowledge goes, lain south of the areas where these carbonaceous clays are now developed. But if this be so, the coal formations would be buried deep beneath the surface, and could only be discovered in the course of boring for other purposes.

To understand the present position on this subject, it may be well briefly to review the geological history of this portion of Egypt, which appears to be as follows. A continent largely composed of granite was slowly sinking beneath a sea which advanced step by step from the northward. As the land sunk the granite was partially worn away, and the sand derived from its decomposition was laid down beneath the sea on the remains of the granite, thus making the great sandy formation known as the Nubian Sandstone. In it fossil trees and imprints of leaves have been occasionally found, showing that vegetation did exist at this period. Fossils of fresh-water river type have also been noted in the sandstone south of Aswân, which indicate that rivers similar to the Nile were descending from the continent to the sea. As the African continent continued sinking and receded southward, the heavy sands could no longer be carried so far north,

being deposited to form the Nubian sandstone in the Sudan. At this period the finer clayey and sandy material with the floating leaves and other small vegetable substance were carried forward to what is now Upper Egypt, and there gently deposited beneath the sea, the result being the intimate intermixture of the clayey matter and the leaves under conditions unfavourable to the accumulation of vegetation in mass, such as gives rise to coal seams of commercial value.

Apart from the speculative possibility mentioned, the discovery of payable coal in Egypt is for all the reasons above-mentioned highly improbable.

APPENDIX IV.

LIST OF GOVERNMENT PUBLICATIONS RELATING TO THE OCCURRENCE OF PETROLEUM IN EGYPT.

- *“Pétrole de la Mer Rouge. Rapport sur les Recherches,” par G. Barois, 1886.
- *“Geology and Petroleum at Ras Gemsah and Gebel Zeit, Report on,” by L. H. Mitchell, 1887.
- *“Petroleum Districts situated on the Red Sea Coast, Report of,” by Colonel C. E. Stewart, C.B., C.M.G., C.I.E., 1888.
- *“Topography and Geology of the Eastern Desert of Egypt (Central Portion),” by T. Barron, A.R.C.S., F.G.S., and W. F. Hume, D.Sc., A.R.S.M., F.G.S., 1902.
- *“Report of the Department of Mines,” 1906.
- “Topography and Geology of the Peninsula of Sinai (Western Portion),” by T. Barron, A.R.C.S., F.G.S., 1907.
- “Oilfields Region of Egypt,” by W. F. Hume, D.Sc., A.R.S.M., etc., 1916.
- “The Geology and Geography of West-Central Sinai,” by J. Ball, PH.D., D.Sc., A.R.S.M., etc., 1916.
- “Rules and Regulations as to Mining,” 1916.
- “Preliminary Report on the Chemistry of Egyptian Petroleum,” by W. A. Guthrie, M.B.E., F.I.C., etc., 1920.
- “Petroleum Research Bulletins,” by W. F. Hume, D.Sc., etc., T. G. Madgwick, A.R.S.M., etc., F. W. Moon, B.E., etc., and H. Sadek, B.Sc., 1920.
- Preliminary Geological Reports on :—
 - †No. 1. “Abu Durba.”
 - No. 2. “The Occurrences of Petroleum in Western Sinai.”
 - No. 3. “Gebel Nazzazat.”
 - No. 4. “Gebel Tanka.”
 - No. 5. “Wadi Mureikha.”
 - No. 6. “Abu Shaar.”
 - No. 7. “South Zeit.”
 - No. 8. “Râs Dîb.”
 - †No. 9. “Geneifa, Shallufa.”
 - †No. 10. “North Sinai.”

* Out of print.

† In course of preparation.

The remainder may be purchased at the sale room of the Government Publications Office, Old Ismailia Palace, Sharia Qasr el Aîni, Cairo.

APPENDIX V.

**LIST OF COMPANIES AND PERSONS HOLDING LICENCES
TO PROSPECT FOR PETROLEUM IN EGYPT.**

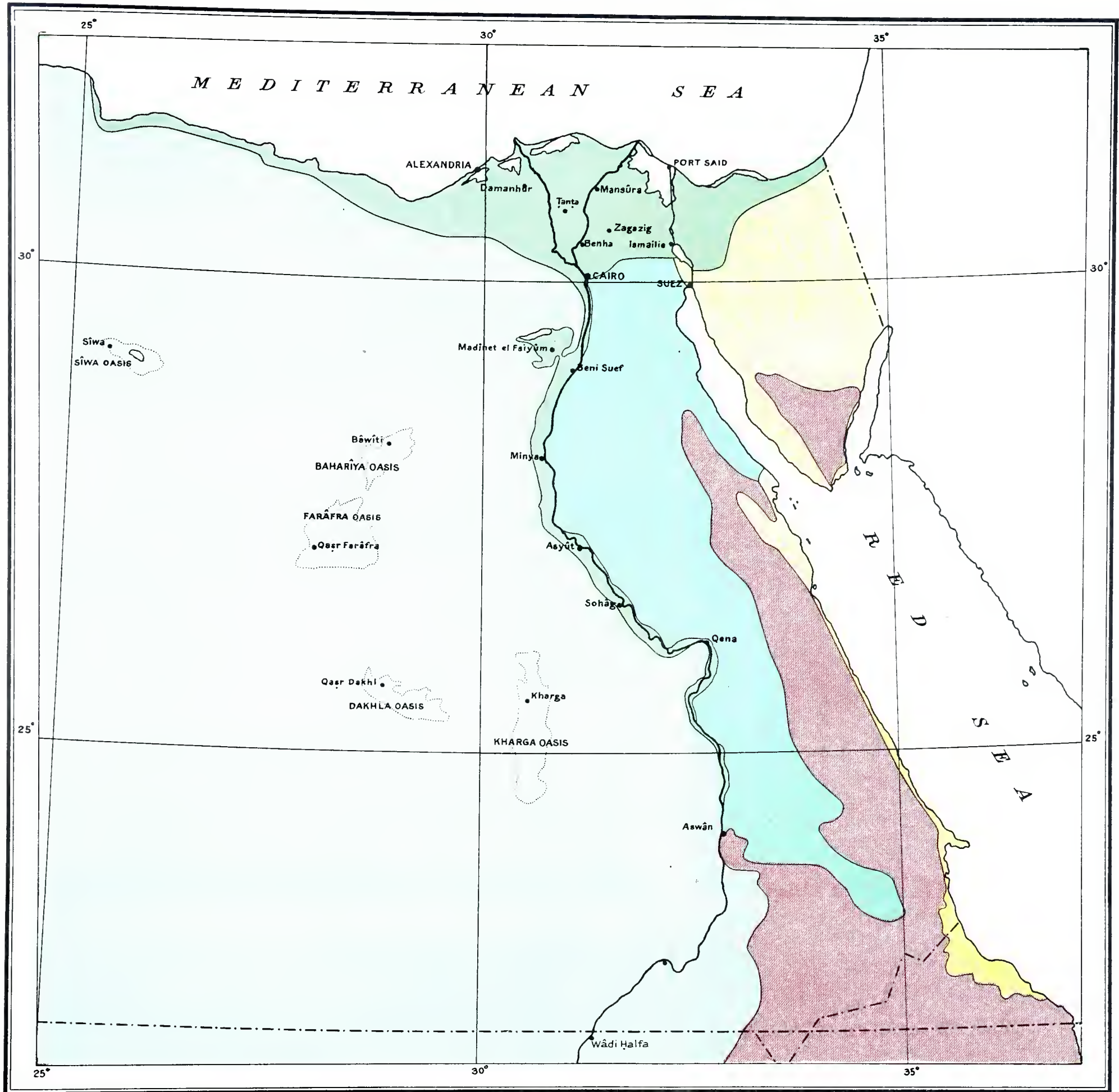
The letters refer to the licensed areas which are shown on the
1 : 2,000,000 map.

A	...	...	A. F. Tunstall.
B	...	...	D'Arcy Exploration Company, Limited.
C	...	...	Whitehall Petroleum Corporation, Limited.
D	...	...	British Sinai Petroleum Company, Limited.
E	...	...	Gemsah Oil Reefs, Limited.
F	...	...	Blattner & Co.
G	...	...	Anglo-Egyptian Oilfields Limited.
H	...	...	Q. S. P. Syndicate, Limited.
I	...	...	Oilfields of Egypt, Limited.
J	...	...	Jubal Syndicate.
K	...	...	Suez Oil Company (1915), Limited.
L	...	...	Sir C. J. Cory, Bart.

Govt. Press 6349-1920-500 ex.

MAP OF EGYPT

showing areas which require examination



Printed by the Survey of Egypt, (21/42)

Scale 1:5,000,000
Kilometres 100 50 0 100 200 300 Kilometres

Area partly examined and under examination at present.
Presence of Petroleum proved possible.

Igneous and metamorphic rocks do not contain petroleum.

Areas obscured by recent accumulations and requiring deep borings.

Unexamined specially for petroleum but existence possible.

Area totally unexplored for petroleum but existence not impossible.

